Publication No. TG 3477
5/97

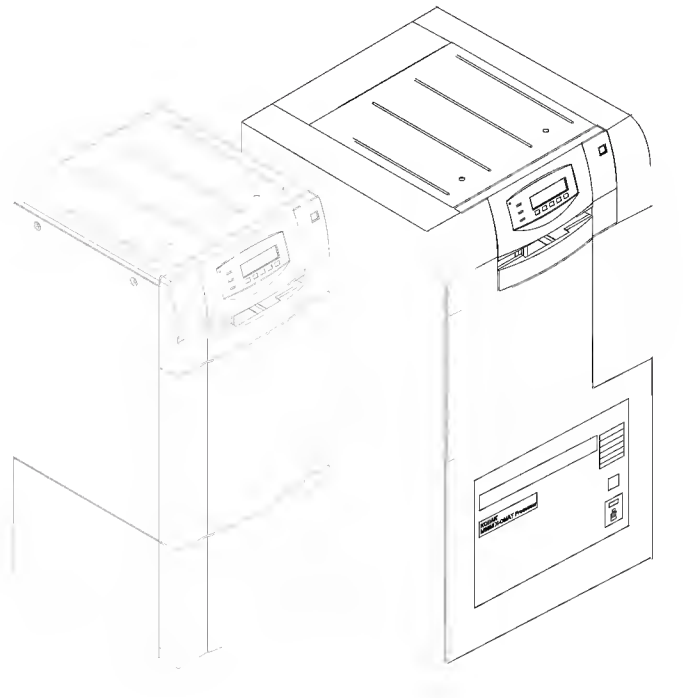
THEORY GUIDE

for the

KODAK Miniloader 2000

and for the

KODAK Miniloader 2000 P



© KODAK AG STUTTGART, 1997

PLEASE NOTE

The information contained herein is based on the experience and knowledge relating to the subject matter gained by Kodak prior to publication.
No patent license is granted by this information.
Kodak reserves the right to change this information without notice, and makes no warranty, express or implied, with respect to this information. Kodak shall not be liable for any loss or damage, including consequential or special damages, resulting from the use of this information, even if loss or damage is caused by Kodak's negligence or other fault.

TABLE OF CONTENTS

ML2000 / ML2000 P versus XML300 1-1
Miniloader 2000 1-2
Miniloader 2000 P 1-3
..... **1-10**
Purpose of the ML 2000 / ML2000 P 2-1
System Overview 2-2
Mechanical System 3-1
1. Frame 3-1
2. Cassette Entrance 3-1
3. Cassette Transport 3-1
4. Cassette Opener 3-1
5. Conveyor 3-1
6. Film Chute 3-1
7. Receiving Magazine Interface 3-2
8. Receiving Magazine 3-2
9. Magazine Holder 3-2
10. Film Pocket assembly 3-2
Pneumatic System 3-2
Film Pocket: 3-3
Cassette Sucker Bar 3-4
MOTORS 3-4
MOTOR M1 (INPUT FLAP) 3-4
MOTOR M4 (CASSETTE CENTRING) 3-4
MOTOR M5 (CASSETTE OPENING) 3-4
MOTOR M6 (CASSETTE FILM PICK UP) 3-5
MOTOR M7 (ROLLER MOTOR) 3-5
MOTOR M10 (FILM POCKET STEPPER MOTOR) 3-5
MOTOR M13 (RECEIVING MAGAZINE INTERFACE MOTOR) 3-5
MOTOR M14 (MAGAZINE OPENING) 3-5
MOTOR M15 (MAGAZINE SUCKER BAR) 3-5
MOTOR M16 (COMPRESSOR) 3-5
Sensors and Switches 3-6
Optical Flag 3-6
Sensor 3-6
Odometer 3-6
Reflective Sensor 3-6
B1/C_FD Switch, Front Door 3-6
B2/C_IN_R Cassette Registration 3-7
B3/C_IN_EO Cassette Input Flap End Switch Open 3-7
B4/C_IF_EC Cassette Input Flap End Switch Closed 3-7
B5/C_IN_EM Cassette In End Switch Middle. 3-7
B10/C_CE_EO Center Bars Opened End Switch 3-7
B11/C_CE_CL, B12/C_CE_CR Cassette Centred Left/Right 3-7
B13/C_CE_L Cassette Length Detection 3-7
B14/C_OP_P Cassette Opener Position 3-7
B15/C_OP_EO Cassette Opener End Switch Open 3-7

B16/C_OP_RO Cassette Really Opened 3-7
B17/C_PU_EF, B18/C_PU_ER Film Pick Up Front/Rear End Switches 3-7
B19/C_PU_T Cassette Sucker Bar Tilt 3-8
B20/C_PU_VO Vacuum Off 3-8
B30/M_PO_HP Home Position, B32/M_PO_ML Mag. Level 3-8
B33/M_RM_P RECEIVING MAGAZINE PRESENT 3-8
B34/M_RM_C Receiving Magazine Code 3-8
B36/M_OP_EO Mag. Open. End Switch Open, B37/M_OP_EC Mag Closing End Switch 3-8
B43/M_CD_1, B49/M_CD-2 Magazine Closed Detection 3-9
B56/M_PU_EF Film Pickup Front End Switch,
B57/M_PU_M Film Pick Up Middle Position,
B58/M_PU_ER Film Pickup Rear End Switch 3-9
B59/M_PU_DS Double Sheet Detector 3-9
B60/M_PU_E Magazine Empty 3-10
B61/M_PU_FS Film At Sucker Bar 3-11
Electronic System **3-12**
Power Supply 3-12
Printed Circuit Board A1 3-12
Printed Circuit Board A2 3-13
Printed Circuit Board A3 (Slave Processor) 3-13
Printed Circuit Board A4 Magazine Interface 3-13
Printed Circuit Board A5 Film Pocket 3-14
Printed Circuit Board A6/1-2 Magazine Sense 3-14
Printed Circuit Board A7 Level Control 3-14
Printed Circuit Board A8 Cassette Interface 3-14
Printed Circuit Board A9 DC Motor Driver 3-14
Printed Circuit Boards A10/1-2 Odometer 3-15
Software **4-1**
1. Administrator Task 4-3
2. Cassette Task 4-3
3.Magazine Task 4-3
Units 4-3
Laptop Computer 4-3
Sequence Of Operation (ML2000) **4-4**
CONDITIONS: 4-4

ML2000 / ML2000 P versus XML300

For the sake of simplicity the KODAK Mulitloader ML2000 and the KODAK Multiloader 2000 P are called in this publication hereafter ML2000 and ML2000 P.

In this chapter the differences between ML2000 / ML2000 P and the XML300 are described. For the sake of simplicity both versions of the MINILOADERS will be called within this publication ML2000. If information is pertinent to the M35-M version only it will be stated.

The ML2000 is based on the XML300. This means a SERVICE PROVIDER trained on the XML300 will be able to service the ML2000.

MAIN FEATURES			
	ML2000	**ML2000 P**	**XML300**
CASSETTE TYPES	MIN R2 BUTTON only	MIN R2 BUTTON only VFH	X-Omatic MIN R2 VIDEO FILM HOLDER C1, C2, C3
CASSETTE SIZES	18x24 cm 24x30 cm	18x24 cm 24x30 cm 8x10 in VFH as accessory only!	18x24 cm, 24x24 cm 24x30 cm, 30x35 cm 30x40 cm, 35x35 cm 35x43 cm, 18x43 cm 20x40 cm, 8x10 in 10x12 in, 11x14 in
SUPPLY MAGAZINES	2	2	3
RECEIVING MAGAZINE	18x24 cm dedicated 24x30 cm dedicated 24X30 cm mixed	not available	not available
INTEGRATED PROCESSOR	not available	M35-M	270RA / 3000RA
SERIAL UNLOAD	not available	YES	YES

Miniloader 2000

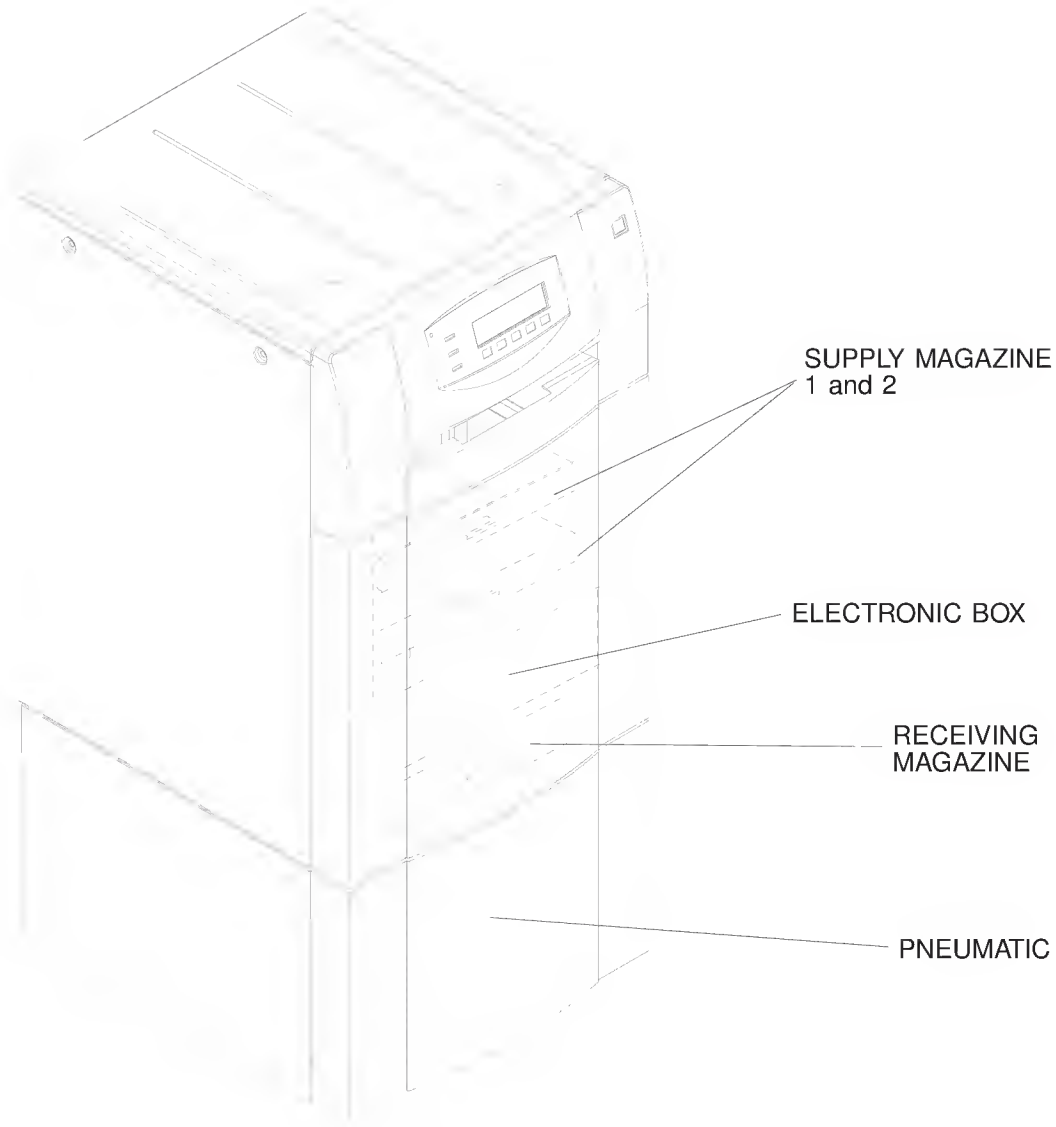


figure 1-1

The ML2000 is a STAND ALONE X-ray film daylight handling system. It can be installed in a lab or in a van. It has no integrated PROCESSOR. Instead of the PROCESSOR a RECEIVING MAGAZINE is used. The RECEIVING MAGAZINE can collect up to 120 sheets of film. The RECEIVING MAGAZINE can be set to dedicated 18x24 cm, to dedicated 24X30 cm or to mixed. If it is set to one of the dedicated modes, only films with the correct size can be used. If it is set to mixed, it accepts 18x24 cm and 24x30 cm films.

If the ML2000 has to be installed in a van, a special INSTALLATION KIT is needed. The kit consists of a plate with several SHOCK ABSORBERS fitted to it.

The SERVICE SOFTWARE for the ML2000 is similar to the XML300 SERVICE SOFTWARE. However the XML300 SERVICE SOFTWARE does not run with a ML2000 and the ML2000 SERVICE SOFTWARE does not run with a XML300.

Miniloader 2000 P

The ML2000 P has an integrated KODAK X-OMAT Processor M35-M. The M35-M is in a STAND below the MINILOADER. There is no RECEIVING MAGAZINE. In contrast to the ML2000 STAND ALONE, the M35-M version has a fixed FILM CHUTE, which guides the FILM into the vertical PROCESSOR INTERFACE. To get access to the PROCESSOR, the ML2000 P can be rolled off with the STAND from the PROCESSOR.

The SERVICE SOFTWARE for the ML2000 and for the ML2000 P is the same. It is similar to the XML300 SERVICE SOFTWARE. However the XML300 SERVICE SOFTWARE does not run with a ML2000 and the ML2000 SERVICE SOFTWARE does not run with a XML300.

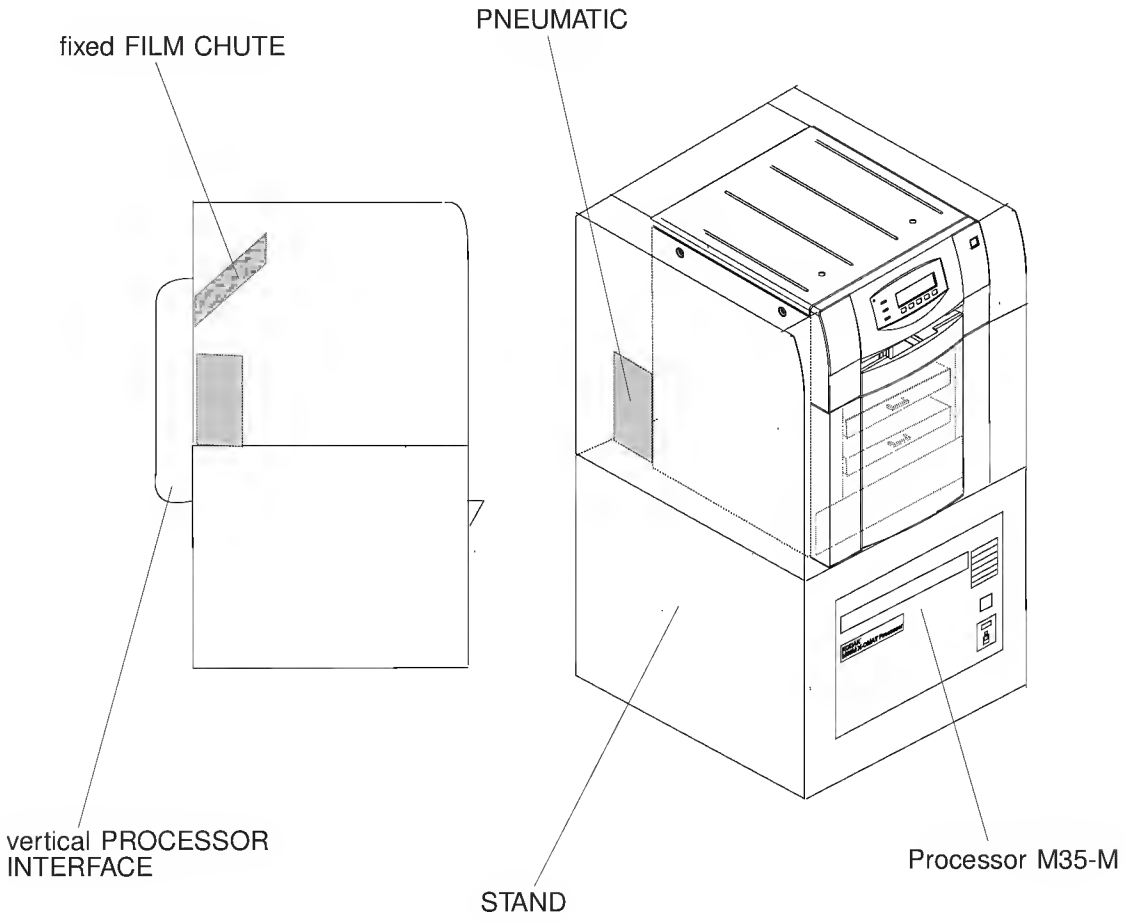
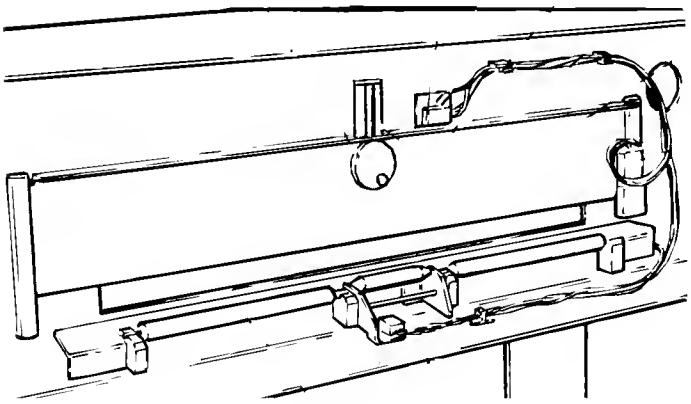


figure 1-2

The following listing gives the deviations of the ML2000 from the XML300.

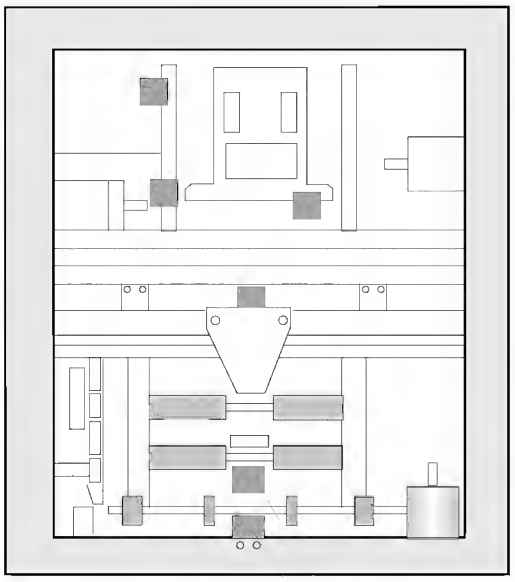
	XML300	ML2000
CASSETTE FEED IN	The CASSETTE pushes down the short DETECTOR ROLLER at the CASSETTE ENTRANCE. SENSOR B2/C_IN_R is made and the CASSETTE TRANSPORT is started.	The CASSETTE has to be pushed in until the LIGHT BARRIER SENSOR B2/C_IN_R is interrupted. This SENSOR is split up into RECEIVER and TRANSMITTER. Both parts are mounted on different boards. As soon as the SENSOR is interrupted, the CASSETTE TRANSPORT is started.

ML300



SENSOR B2

ML2000

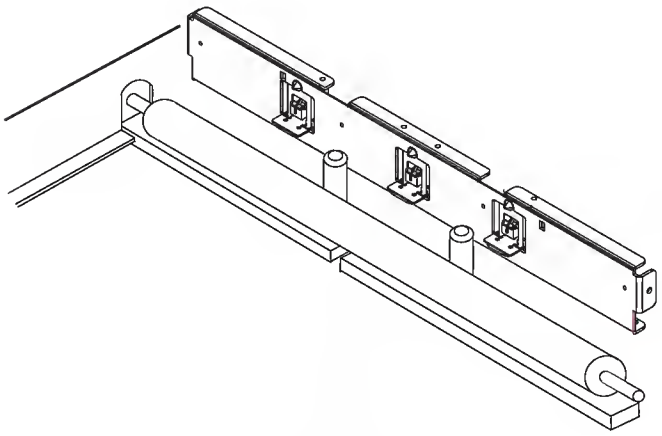


SENSOR B2 TRANSMITTER and RECEIVER

figure 1-3

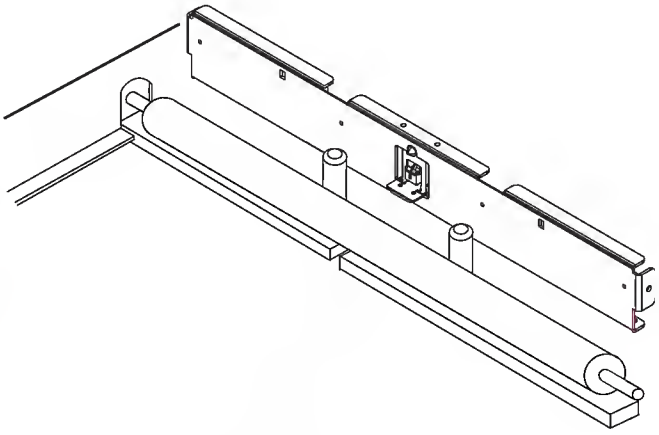
	XML300	ML2000
The CASSETTE is transported to the CASSETTE END STOP	SENSOR B24/C_IN_R2 detects if a CASSETTE is fed in. The CASSETTE is transported to the 3 CASSETTE END SWITCHES (B5, B6, B7), the HOLDING FINGER moves forward and the INPUT FLAP is closed.	SENSOR B24/C_IN_R2 is not used in the ML2000. Only 1 END SWITCH (B6/C_IN_EM) is used. A HOLDING FINGER does not exist. The INPUT FLAP becomes closed as soon as B6 is actuated.

ML300



SENSOR B6

ML2000



SENSOR B6

figure 1-4

The CASSETTE is centred	Both CENTRING BARS move in until the CASSETTE is centred (B11 and B12 actuated). The innermost and the outermost positions of the CENTRING BARS are monitored by 2 SENSORS B9/C_CE_EC and B10/C_CE_EO.	Both CENTRING BARS move in until the CASSETTE is centred (B11 and B12 actuated). The outermost position of the CENTRING BARS is monitored with SENSOR B10/C_CE_EO. There is no SENSOR for the innermost position. After the CASSETTE is centred, the actual film size is known. The FILM CHUTE of the ML2000 is set with a PNEUMATIC CYLINDER to the correct width. This ensures that the FILM is guided correctly into the RECEIVING MAGAZINE. **NOTE** The FILM CHUTE of the ML2000 P is fixed. It cannot be set to different widths.

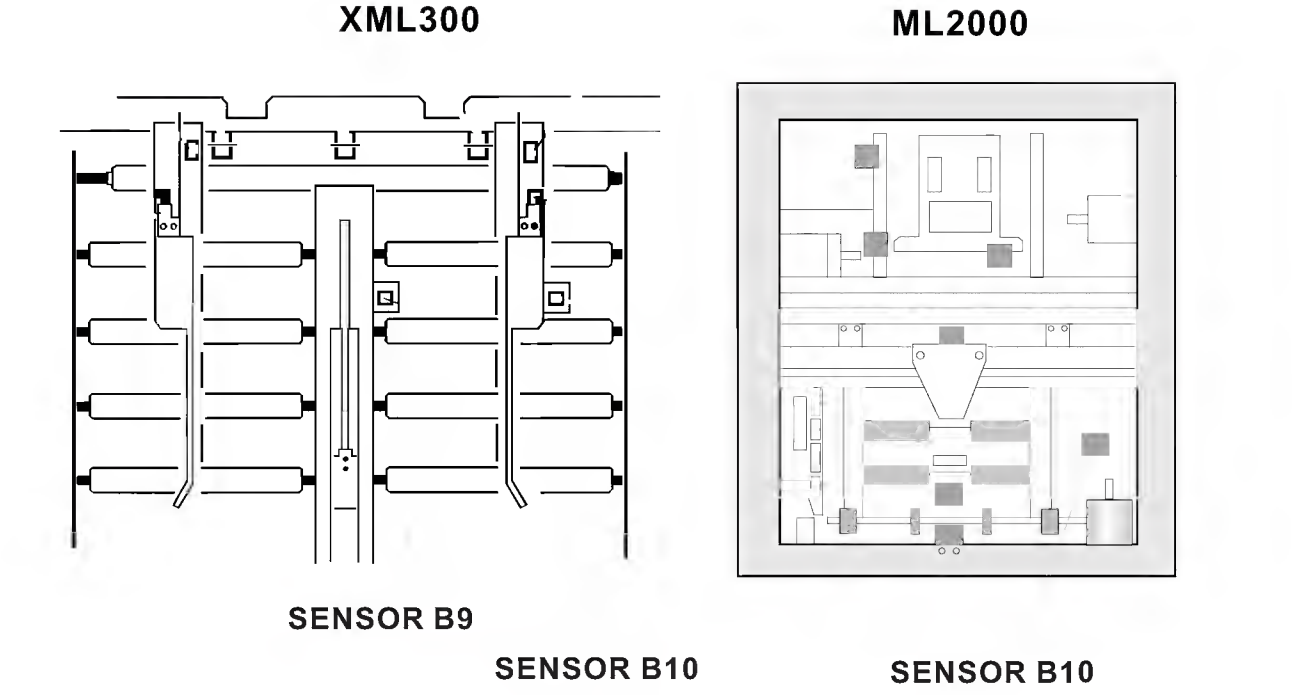


figure 1-5

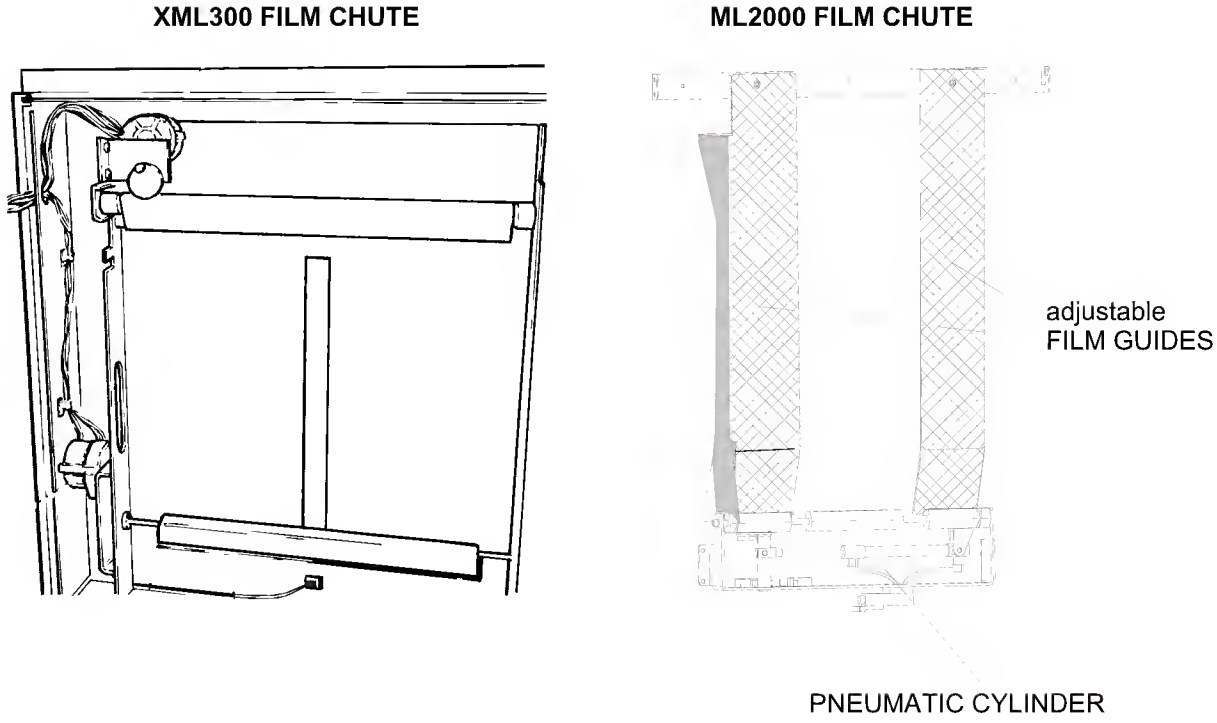


figure 1-6

	XML300	ML2000
The CASSETTE becomes opened	The CASSETTE OPENER stops for a short moment in the BLOW POSITION. The BLOW PIPES are switch on to separate the FILM from the upper screen. The CASSETTE OPENER moves then to the fully open position.	The CASSETTE OPENER goes to the fully open position. There are no BLOW PIPES to separate the FILM from the upper screen. That´s why only BUTTON CASSETTES can be used.
FILM POCKET moves to the selected SUPPLY MAGAZINE	the same procedure for all systems	
The FILM is picked up from the CASSETTE and transported through the CONVEYOR.	The same procedure for all systems. The CONVEYORS are identical.	
The exposed FILM is transported to the PROCESSOR	The exposed FILM leaves the CONVEYOR, enters the FILM CHUTE, is stopped and aligned by the FILM RELEASE. The FILM RELEASE opens and the FILM enters the PROCESSOR INTERFACE and is transported into the PROCESSOR. As long as the exposed FILM is in the FILM CHUTE, the INTERFACE FLAP is closed.	The exposed FILM leaves the CONVEYOR and enters the FILM CHUTE. **ML2000:** The FILM CHUTE is adjusted to the correct FILM WIDTH. The FILM goes straight through the FILM CHUTE into the RECEIVING MAGAZINE INTERFACE and then into the RECEIVING MAGAZINE. In the FILM CHUTE there is no FILM SENSOR, no INTERFACE FLAP and no FILM RELEASE. There is just an adjustable FILM GUIDE. **ML2000 P:** The FILM CHUTE of this system is a fixed one. It guides the exposed FILM to the vertical PROCESSOR INTERFACE mounted to the STAND. From there the FILM goes into the PROCESSOR.

ML2000 RECEIVING MAGAZINE WITHIN THE MAGAZINE CHUTE
rear view

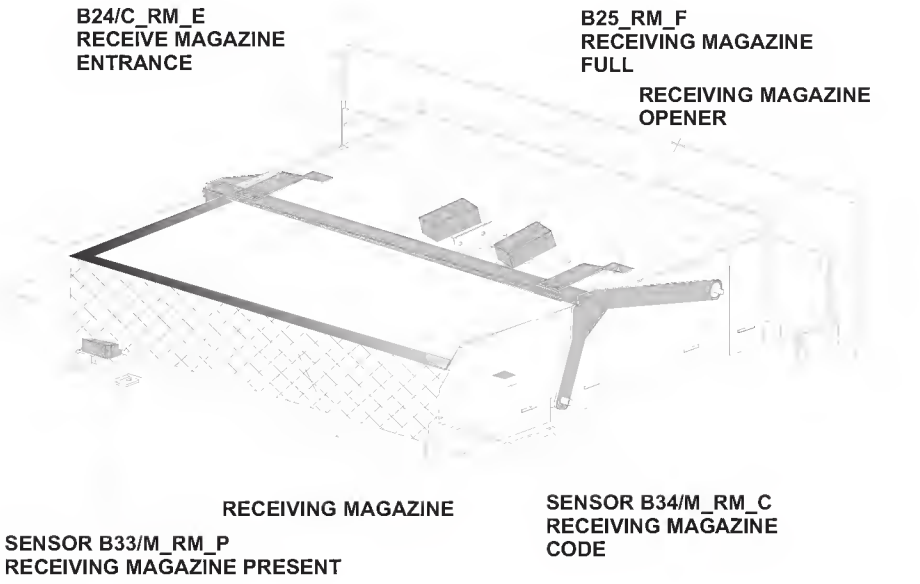


figure 1-7

	ML300	ML2000
POWER SUPPLY	Linear POWER SUPPLY located in the rear right of the XML300	Linear POWER SUPPLY located in the ELECTRONIC BOX
PRINTED CIRCUIT BOARDS	At various locations around the unit.	PCBs A1, A3/1, A3/2, A4, A8, A9 are in the ELECTRONIC BOX. They are the same as the XML300 PCBs. **NOTE** **The software on PCBs A1, A3/1 and A3/2 is not the XML300 software. It is different!** PCB A5 is the same as in the XML300. PCB A6 (MAGAZINE CODE) and PCB A7 (LEVEL CONTROL) are different than in the XML300.
COUNTER	SOFTWARE COUNTER accessible via the DISPLAY	ELECTROMECHANICAL COUNTER, located at the front of the ELECTRONIC BOX. Accessible when the MAGAZINE DOOR is open.

ELECTRONIC BOX
ML2000 / ML2000M35M

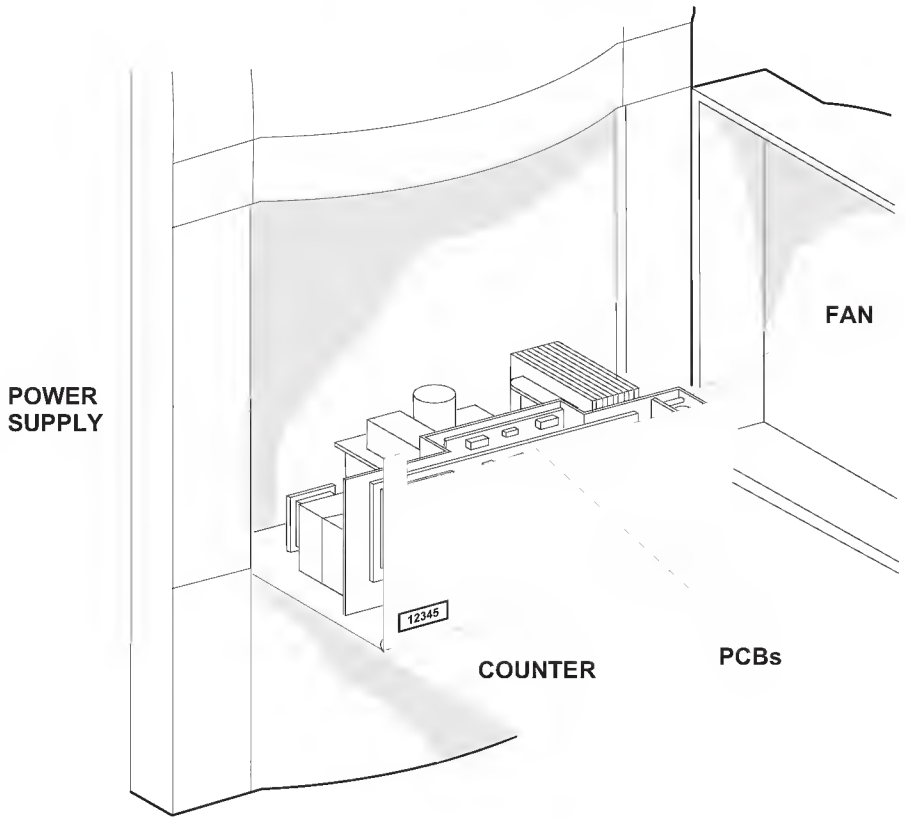


figure 1-8

PNEUMATIC	The VACUUM PUMP / COMPRESSOR is located at the left-hand side. The PNEUMATIC ASSEMBLY (SOLENOID VALVES) and the WATER TRAPS are at the rear left.	**NOTE** The PNEUMATIC ASSEMBLY differs from the one of the XML300. The SOLENOID VALVE CASSETTE BLOWING is not installed. **ML2000:** The complete PNEUMATICS is in the MINILOADER STAND. **ML2000 P:** The COMPRESSOR / VACUUM PUMP, PNEUMATIC ASSEMBLY and WATER TRAPS are at the rear of the MINILOADER. They are mounted underneath the FILM CHUTE.

Purpose of the ML 2000 / ML2000 P

The Miniloader 2000 is a daylight handling system for radiographic films. The Miniloader 2000 System consists of the Miniloader 2000 and Mammography CASSETTES. The exposed FILMS are stored in a RECEIVING MAGAZINE. The FILMS will be processed at a later time in a separate PROCESSOR.

The ML2000 P has in addition an integrated PROCESSOR. In this case a RECEIVING MAGAZINE is not available.

Sequence of a normal cycle:

A cassette contains an exposed radiographic film.(1)

The cassette is fed into the ML2000. (2)

The ML2000 opens the cassette and removes the exposed film. (3)

The film is transported to the RECEIVING MAGAZINE. (4)

After the cassette has been unloaded the ML2000 puts a fresh film into the cassette. (5)

After the cassette has been reloaded the ML2000 closes and sends out the cassette.

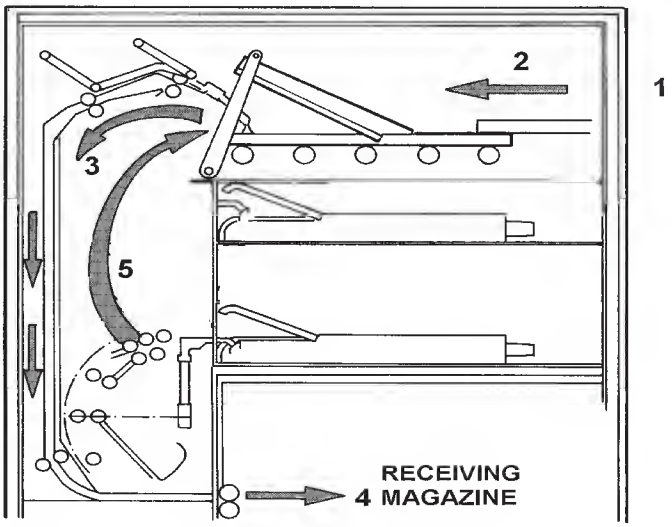


figure 2-1

System Overview

The Miniloader 2000 contains the following basic systems:

1. Mechanical System
2. Electromechanical System
3. Electronic System
4. Software

The Mechanical System is divided into the following subsystems:

1. Frame
2. Cassette Entry
3. Conveyor
4. Film Chute
5. Receiving Magazine Interface
6. Receiving Magazine
7. Magazine Holder
8. Film Pocket

The Electromechanical System consists of:

1. Compressor System
2. Vacuum System
3. Motors
4. Fans

The Electronic System consists of:

1. Circuit Boards
2. Sensors
3. Power Supply

Mechanical System

1. Frame

Purpose of the frame:
It holds all the modules of the ML2000 in the proper position.
The frame is a steel construction.

2. Cassette Entrance

Purpose of the Cassette Entrance:
The Cassette Entrance detects the cassette when it is fed into or out of the ML2000 and can be closed to make the system light tight.
The Cassette Entrance consists of:
A roller, a sensor assembly to detect cassettes and an Input Flap to close the entrance.

3. Cassette Transport

Purpose of the Cassette Transport:
The cassette transport mechanism transports the cassette to the correct position where it can be opened, unloaded and loaded. In addition the cassette size is measured. The cassette transport mechanism sends out the cassette after it has been loaded with a fresh film.
The Cassette Transport consists of:

- A roller transport mechanism for feeding in and the out the cassette.
- Two Centering Bars that centrethe CASSETTE and measure the Cassette Length.

4. Cassette Opener

Purpose of the Cassette Opener:
The Cassette Opener opens and closes the cassette.
The Cassette Opener consists of:
The opener bar with a moveable opener wedge and two moveable hooks.

5. Conveyor

Purpose of the Conveyor:
The Conveyor removes the exposed film from the cassette and transports the film to the Film Chute.
The Conveyor consists of:

- The Sucker Bar Carriage to remove the film from the cassette.
- The roller transport mechanism to transport the film to the Film Chute.

6. Film Chute

Purpose of the Film Chute:
The Film Chute guides the exposed film from the Conveyor to the RECEIVING MAGAZINE INTERFACE.
The Film Chute is automatically set to the correct film size.

7. Receiving Magazine Interface

Purpose of the Receiving Magazine Interface:
The Receiving Magazine Interface transports the exposed film from the Film Chute to the RECEIVING MAGAZINE.

8. Receiving Magazine

Up to 200 exposed FILMS are stored in the RECEIVING MAGAZINE. The FILMS will be processed at a later time in a separate PROCESSOR.

9. Magazine Holder

Purpose of the Magazine Holder:
The Magazine Holder holds the two magazines in the correct position. The magazine becomes unlatched (but not opened) when it is inserted in the Magazine Holder. The Magazine Holder also opens and closes the magazine lids by a bracket.
The Magazine Holder consists of:

- 4 guides to hold and unlatch the 2 magazines.
- A spring loaded bracket to lift the magazine lids.

10. Film Pocket assembly

Purpose of the Film Pocket Assembly:
The Film Pocket takes a film from the magazine and puts it into the cassette.
The Film Pocket Assembly consists of:

- A Sucker Bar Assembly to grasp the film.
- Two deflectors to make sure that only one film is taken out of the magazine.
- A Double Film Detector to detect if a second film sticks to the film which has been taken out of the magazine.
- A Sensor to detect if the magazine is empty.

Pneumatic System

The Pneumatic System consists of:

- 6 solenoid valves
- An film chute cylinder
- A compressor
- A bleeder valve
- A strainer with a water trap
- Two sucker bars to pick up film
- Two sets of blow pipes for film separation

The compressor is used to generate the vacuum and the pressure for the entire pneumatic system. The film chute cylinder is used to set the FILM CHUTE to the correct width. The Magazine Sucker Bar is used to pick up the film from the magazines. The blow pipes on the Magazine Film Pocket are used to separate the films in the magazine to avoid double film loading in the cassette. The Cassette Sucker Bar is used to pick up the exposed film from the cassette and to deliver it to the roller transport mechanism.
The Bleeder valve switches when the pressure has reached 4 bars. This limits the pressure to 4 bars.
The strainer and the water traps protect the magnetic valves against dirt and humidity.

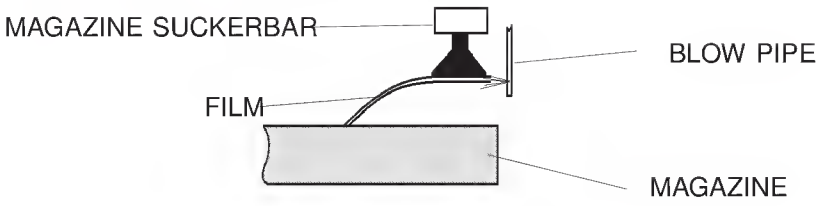


figure 3-1

The symbol for the solenoid valves should be read as shown in the figure below. The right hand position is the position if the solenoid valve is deenergized.

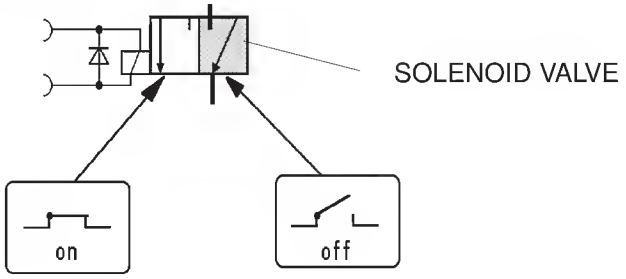


figure 3-2

Film Pocket:

For the correct operation of the pneumatic system it is necessary that the compressor can suck air during the venting of the blow pipes. The air is supplied by the solenoid valve Y12 to create the vacuum at the magazine suckers, the compressor also has to bleed air.

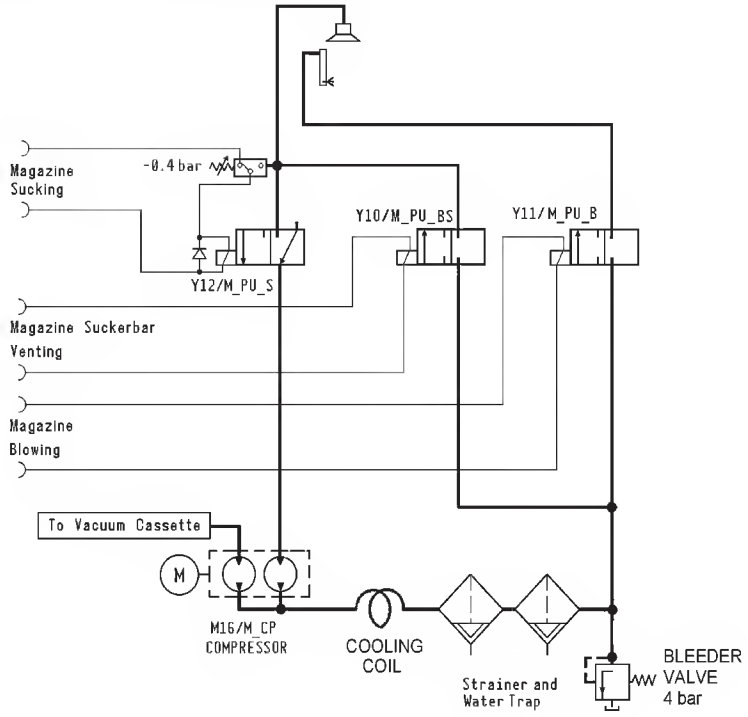


figure 3-3

Cassette Sucker Bar

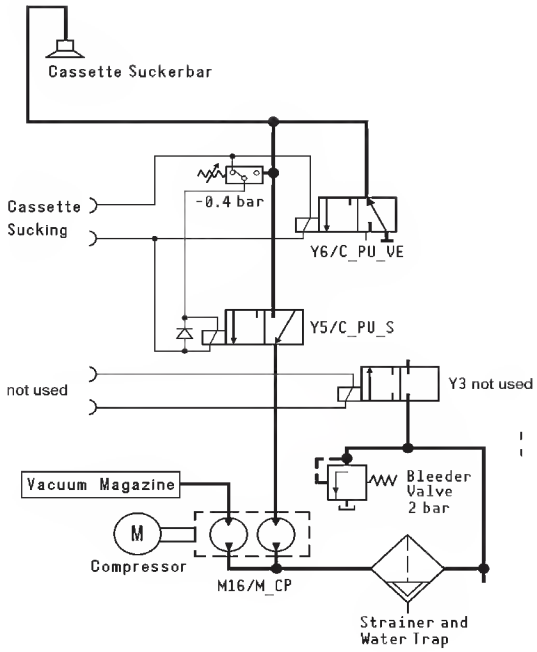


figure 3-4

MOTORS

All AC MOTORS have an operating voltage of 115 V and can be used with 50 Hz or 60 Hz.

MOTOR M1 (INPUT FLAP)

MOTOR M1 is a 115VAC motor. Motor M1 opens and closes the CASSETTE INPUT FLAP. The position of the CASSETTE INPUT FLAP is detected by 1 SENSOR. SENSOR B3/C_IF_EO is actuated when the CASSETTE INPUT FLAP is completely opened.

MOTOR M4 (CASSETTE CENTRING)

Motor M4 is a 115VAC MOTOR. It moves the CASSETTE CENTRING BARS in and out. SENSOR B10/C_CE_EO actuates when the CENTRING BARS are in the outermost position. SENSOR B9/C_CE_EC actuates when the CENTRING BARS are in the innermost position. SENSORS B11/C_CE_RL and B12/C_CE_CR are actuated when a CASSETTE is clamped between the CENTRING BARS. ODOMETER PCB A10/2 SENSOR B13 measures the cassette length.

MOTOR M5 (CASSETTE OPENING)

MOTOR M5 is a 20VDC motor. It drives the CASSETTE OPENER mechanism. SENSOR B15/C_OP_EO is actuated when the CASSETTE OPENER is in the uppermost position.ODOMETER PCB A1 SENSOR B14 measures the position of the CASSETTE OPENER in relation to the uppermost position.

MOTOR M6 (CASSETTE FILM PICK UP)

MOTOR M6 is a 115VAC motor. It drives the CASSETTE SUCKER BAR CARRIAGE in and out of the CASSETTE. The position of this CARRIAGE is sensed by SENSORS B17/C_PU_EF and B18/C_PU_ER. SENSOR B18 is actuated when the CARRIAGE is fully back and SENSOR B17 is actuated when the CASSETTE SUCKER BAR is fully in the CASSETTE.

MOTOR M7 (ROLLER MOTOR)

MOTOR M7 is a 115VAC motor. If drives the transport mechanism in the CONVEYOR. MOTOR M7 is switched on after the vaccum for the CASSETTE SUCKER BAR is switched on. MOTOR M7 is switched off 1.5 sec. after the film trailing edge passed SENSOR B20/C_PU_VO.

MOTOR M10 (FILM POCKET STEPPER MOTOR)

MOTOR M10 is a STEPPER MOTOR. It transports the FILM POCKET to the MAGAZINE LEVELS, HOME POSITION and to the CASSETTE LEVEL. The position of the FILM POCKET is detected by SENSORS and by the amount of steps (pulses) sent to MOTOR M10.

MOTOR M13 (RECEIVING MAGAZINE INTERFACE MOTOR)

MOTOR M13 is a STEPPER MOTOR. It drives the TRANSPORT ROLLERS of the RECEIVING MAGAZINE INTERFACE.

MOTOR M14 (MAGAZINE OPENING)

MOTOR M14 is a 115VAC motor. It opens and closes the magazines. The open position is detected by SENSOR B36/M_OP_EO and the closed position is detected by SENSOR B37/M_OP_EC.

MOTOR M15 (MAGAZINE SUCKER BAR)

MOTOR M15 is a 115VAC motor. It moves the MAGAZINE SUCKER BAR in and out. 3 SENSORS, located on PCB A5, monitor the position of the MAGAZINE SUCKER BAR.
SENSOR B56/M_PU_EF = SUCKER BAR IN.
SENSOR B57/M_PU_M = SUCKER BAR in middle position.
SENSOR B58/M_PU_ER = SUCKER BAR fully out.

MOTOR M16 (COMPRESSOR)

MOTOR M16 has 2 functions. It is used as COMPRESSOR and as VACUUM PUMP.

Sensors and Switches

In the ML2000 different types of sensors are used although the electronic symbol for all of them is the same. In all manuals they are all called sensor only. The differences between them are the mechanical configurations.

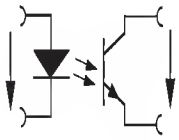


figure 3-5

There are:

Optical Flag

The Optical Flag looks similar and is mechanically applied like a switch. The actuator is spring loaded. In the non actuated position the actuator interrupts the light beam between the transmitter and the receiver. When the actuator is actuated the light beam from the transmitter passes to the receiver.

Sensor

This sensor is used in two applications. To detect mechanical positions by being interrupted by a bracket. To measure distances and to detect mechanical positions in combination with a rotating timing disc. This kind of assembly is called Odometer.

Odometer

This type of sensor is used for position detections by measuring rotations in fixed steps. It can also detect the direction of the rotation.

Reflective Sensor

In this sensor the receiver and the transmitter are located in parallel. To actuate the sensor, the light beam from the transmitter is reflected back to the receiver. This is done by a mirror or a reflective foil.

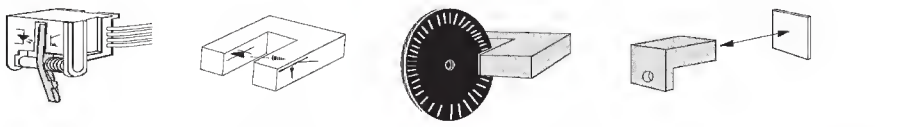


figure 3-6

B1/C_FD Switch, Front Door

This switch is actuated when the front door is closed.

B2/C_IN_R Cassette Registration

This Sensor (LIGHT BARRIER) is located at the entrance of the ML2000. The Sensor B2/C_IN_R detects the cassette at the entrance of the ML2000.

B3/C_IN_EO Cassette Input Flap End Switch Open

This Sensor (Optical Flag) is actuated when the Cassette Input Flap is fully opened.

B4/C_IF_EC Cassette Input Flap End Switch Closed

This sensor (Optical Flag) is actuated when the Cassette Input Flap is fully closed.

B5/C_IN_EM Cassette In End Switch Middle.

This OPTICAL FLAG is used to detect the cassette at the Cassette End Stop.

B10/C_CE_EO Center Bars Opened End Switch

SENSOR B10 (Optical Flag) is used to detect the position of the two Centering Bars.

B11/C_CE_CL, B12/C_CE_CR Cassette Centred Left/Right

These two sensors (Optical Flags) are used to detect that the cassette is centred between the Cassette Centering Bars. The cassette is centred only when both sensors are actuated.

B13/C_CE_L Cassette Length Detection

This sensor is a part of the Odometer A10/1. It is a used to measure the cassette length.

B14/C_OP_P Cassette Opener Position

This sensor is a part of the Odometer A10/2. It is used to detect the middle and the bottom position of the Cassette Opener Assembly.

B15/C_OP_EO Cassette Opener End Switch Open

This sensor (Optical Flag) is used to detect the open position of the Cassette Opener.

B16/C_OP_RO Cassette Really Opened

This sensor is used to detect whether the cassette is really opened after the Opener Assembly has reached the Sensor B15 (Cassette Opener). The Sensor B16 becomes actuated by the lid of the cassette.

B17/C_PU_EF, B18/C_PU_ER Film Pick Up Front/Rear End Switches

These two sensors are used to detect the front and the rear position of the Cassette Sucker Bar Carriage. The front position B17 of the Cassette Sucker Bar Carriage is the position where the sucker bar is located in the cassette. The rear position (B18) is the home position of the Cassette Sucker Bar Carriage. The two sensors are located opposite to the left hand drive belt of the Cassette Sucker Bar Carriage. The mirror for the detection is located on the drive belt.

B19/C_PU_T Cassette Sucker Bar Tilt

This sensor (Optical Flag) is used to detect if the Cassette Sucker Bar is in the Tilt Position. The purpose of the tilting of the Cassette Sucker Bar:

.

B20/C_PU_VO Vacuum Off

This sensor is located at the entrance of the Conveyor. The signal of Sensor B20/C_PU_VO is used to switch off the vacuum of the Cassette Sucker Bar. After the Cassette Sucker Bar has been tilted, the Sucker Bar Carriage moves to the rear position. The film is put between the rollers at the entrance of the Conveyor before the Sucker Bar Carriage is at the rear (home) position. Therefore the vacuum on the Cassette Sucker Bar has to be switched off before the Sucker Bar Carriage has reached the rear position. Otherwise film jams would occur in the Conveyor. The vacuum is switched off a short time after the leading edge of the film has reached the Sensor B20/C_PU_VO.

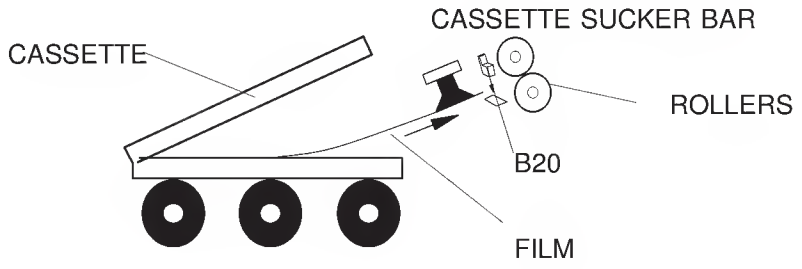


figure 3-7

B30/M_PO_HP Home Position, B32/M_PO_ML Mag. Level

Sensor B30/M_PO_HP Home Position is used to detect the Home Position of the Film Pocket Assembly. **Sensor B32/M_PO_ML Magazine Level** is used to detect the correct positions of the Film Pocket at the magazines and the Cassette Level, where the Magazine Sucker Bar can move into the magazines or the cassette.

B33/M_RM_P RECEIVING MAGAZINE PRESENT

SENSOR B33/M_RM_P is actuated, when the RECEIVING MAGAZINE is fully inserted.

B34/M_RM_C Receiving Magazine Code

SENSOR B34/M_RM_C reads the Magazine Code (Magazine size).

B36/M_OP_EO Mag. Open. End Switch Open, B37/M_OP_EC Mag Closing End Switch

These two sensors detect the positions of the opener assembly of the magazines.

B43/M_CD_1, B49/M_CD-2 Magazine Closed Detection

These two sensors are actuated by a reflective foil on the magazine lids. One sensor is used per Magazine Level.
B43/M_CD_1: Magazine Level 1.
B49/M_CD_2: Magazine Level 2.
They are located on the Printed Circuit Boards A6/1-2. Each sensor is actuated when the magazine lid is closed.

B38, B39, B40 (/M_SD_11-13),
B44, B45, B46 (/M_SD_21-23),
They are located on the Printed Circuit Boards A6/1-2. They are used to detect the film sizes of the magazines. The sensors are actuated by reflective labels which are installed to side of the magazine. For more details of the function of these sensors see description of Printed Circuit Board A6.

B56/M_PU_EF Film Pickup Front End Switch, B57/M_PU_M Film Pick Up Middle Position, B58/M_PU_ER Film Pickup Rear End Switch

These three sensors are located on the Printed Circuit Board A5. They detect the positions of the Magazine Sucker Bar.

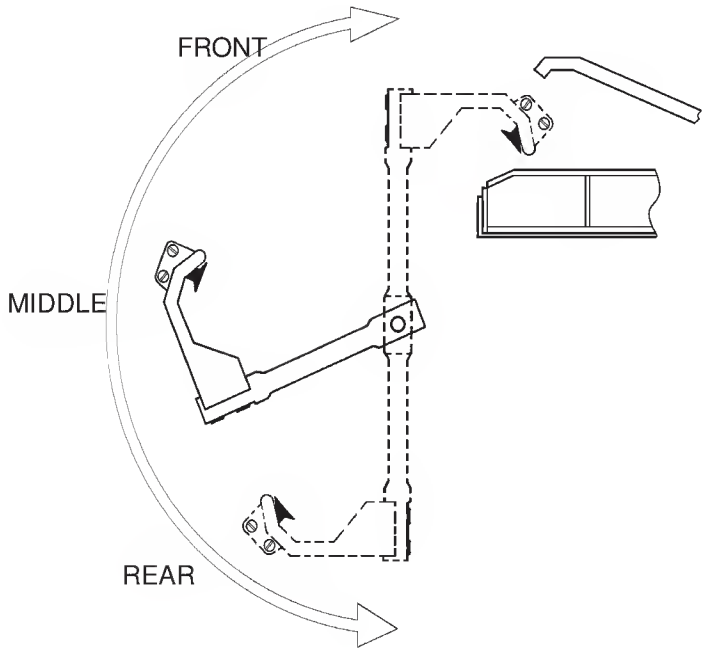


figure 3-8

B59/M_PU_DS Double Sheet Detector

The Double Film Detector measures the thickness of film before the Magazine Sucker Bar moves out of the magazine. Sensor B59/M_PU_DS is actuated when the measured thickness of the film is < 0.3 mm or > 0.05 mm. The thickness of one film is about 0.2 mm. Therefore the X-OMAT Multiloader 300 assumes

that a thickness above 0.3 mm or below 0.05 mm has to be caused by a second film sticking to the film at the Magazine Sucker Bar.

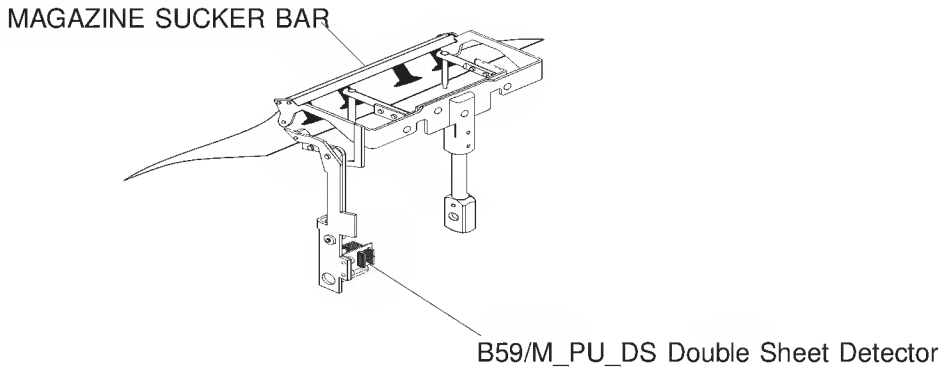


figure 3-9

B60/M_PU_E Magazine Empty

This sensor consists of a transceiver. This means it sends and detects an infrared light beam. Sensor B60/M_PU_E is actuated when the magazine is empty. The light beam coming from the Sensor B60/M_PU_E becomes reflected by a mirror on the Magazine Sucker Bar into the magazine. The light beam is directed to a spot on the bottom of the magazine where a reflective foil is placed. As long as there is a film in the magazine the light beam becomes absorbed by the surface of the film. To insure the films do not become exposed by the Sensor B60 the transmitter is switched on by pulses to reduce the amount of light. When there is no film in the magazine the reflective foil reflects the light beam via a mirror back to the Sensor B60. The sensor is read before the Magazine Sucker Bar moves into the magazine and when the Magazine Sucker Bar moves from the Pick Up Front Position to the Pick Up Rear Position.

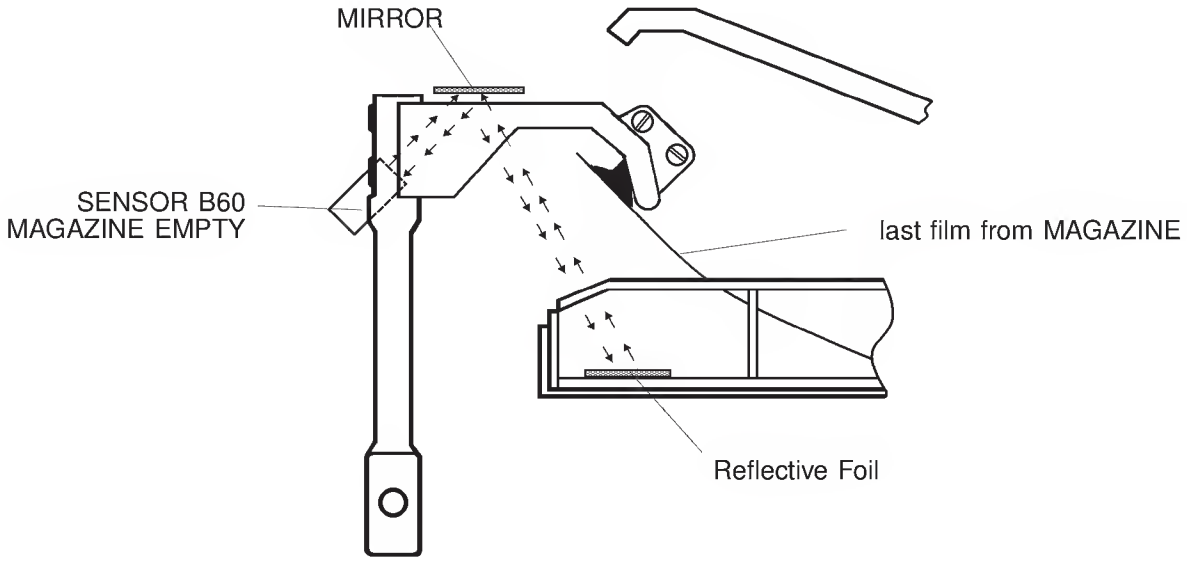


figure 3-10

This enables the Multiloader 2000 to detect that a magazine is empty when removing the last film from the magazine.

B61/M_PU_FS Film At Sucker Bar

This sensor is placed on the Magazine Sucker Bar. The purpose of Sensor B61/M_PU_FS is to detect a film at the sucker bar of the Film Pocket. The output of Sensor B61 is used in several steps of the cycle of the Film Pocket:

To detect that the Film Pocket Sucker Bar has reached the film stack in the magazine:
Since the height of the film stack in the magazines varies there is no fixed position for the Film Pocket for picking up the film from the magazine. Therefore after moving into the magazine the Film Pocket moves down until Sensor B61 is actuated. The Film Pocket stops after some additional steps of the stepper motor after Sensor B61 has been actuated. The purpose of the additional steps is to remove the clearance between the suckers and the film and to compensate for the tolerance of the sensor.

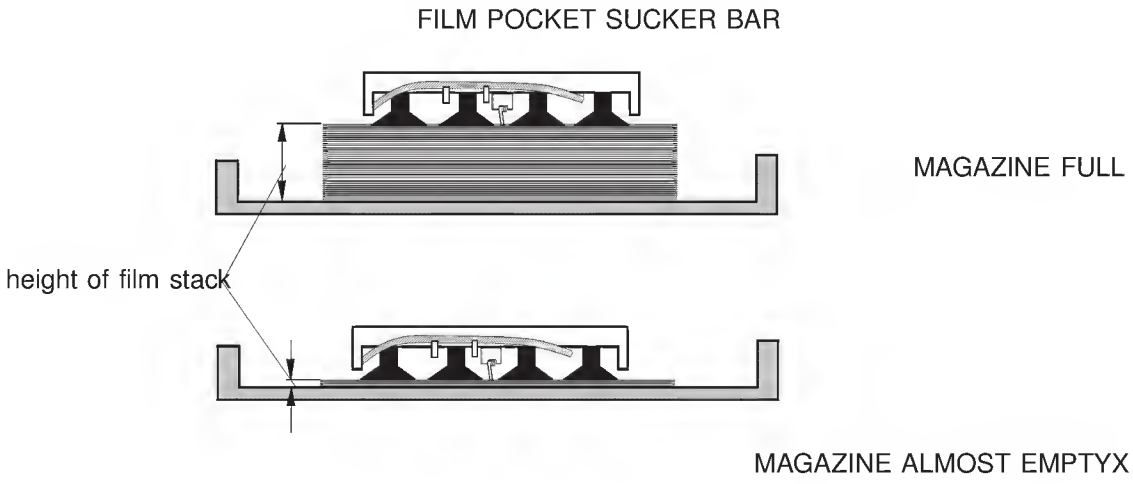


figure 3-11

To detect if the fresh film is removed from the Magazine Sucker Bar after it has been blown off into the cassette.

Electronic System

Power Supply

The power supply consists mainly of one transformer, one contactor, PCB A0, an EMI-filter, two interlock switches and several fuses. The power supply can be adapted to different voltages by changing the wiring at the transformer. The DC-voltages are not regulated on the power supply. The voltages are regulated on the printed circuit boards. The purpose of this is to increase the reliability of the electronics. The electronics on the printed circuit boards become less sensitive to noise on the wires from the power supply to the printed circuit boards. The electronic on the printed circuit boards becomes also less sensitive in relation to a voltage drop on the wires connecting the power supply with the printed circuit boards. The voltage regulation becomes also less expensive by this. The EMI-filter is used to protect the electronics from electrical noise from the line. Relay K1 is controlled by the B23 TOP COVER INTERLOCK. RELAY K2 is controlled by SENSOR B1 FRONT DOOR INTERLOCK. RELAYS K1 and K2 must be energised to energise CONTACTOR K0. If not both INTERLOCKS are made, CONTACTOR K0 is not energised and the 115VAC to PCBs A4 and A8 are switched off. VPE 20 to PCB A9 is then switched off too. The fan for the venting of the system is turned on as soon as the Minloader 2000 is switched on.

Printed Circuit Board A1

This is the Main Microprocessor Board. The following parts are installed to the circuit board:

- A 80188 microprocessor.

The microprocessor is used to drive all inputs, outputs and the program on this BOARD. The 80188 is a microprocessor that has an external 8 bit data bus and an internal 16 bit data bus. The microprocessor has an integrated Interrupt controller is used to generate a interrupt hierarchy for the peripheral circuits which communicate with the microprocessor. A wait state generator for adapting the microprocessor to the response time of periphery circuits. A quarz clock generator for the system clock frequency of 16 MHz. An address decoder to select the RAM-, E-PROM etc. Three timer circuits.

- Two Flash E-PROMS for the main program.

The Flash E-PROMS are components which store program data. The Flash E-PROMS can be electrically erased and programmed on the circuit board. The Flash E-PROMS can be programmed only in total. That means it is only possible to erase all data in the Flash E-PROMS at once to enable the circuit to be reprogrammed. Except for the function explained above, the Flash E-PROMS work similar to E-PROMS and PROMS.

A RAM section to store parameters or performance data, like failures and cycle counter.

A battery for the back up of the RAM memory. When the Miniloader 2000 is switched off, the battery supplies the RAM with the power needed to keep the data in the memory. The battery life is approx. 7 to 10 years. In parallel to the battery is a capacitor which can also supply the RAM with the voltage needed to keep the data. The prevents the data from being lost when the battery is exchanged.

A real time clock timer used for the clock that displays the time and the date.

A parallel interface for communication with the Display and the User Keyboard.

Four RS 232 serial interfaces: Two interfaces for the two Slave Processors. One interface for the communication with the LAP TOP-computer. The communication between the microprocessor and the RS 232 interfaces is done by interrupt routines. All the interfaces have drivers installed between the microprocessor and the output. One RS232 interface is not used in the Miniloader 2000.

An E-PROM. The E-PROM is a part of the memory that contains the bootstrap software of the microprocessor. There are for example the following routines:
Communication between RS 232 interfaces, communication between the parallel interfaces, programming of the Flash E-PROMS etc.

Printed Circuit Board A2

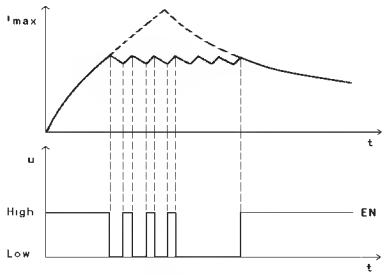
This board is an interface between the printed circuit board A1 (Main Processor) and the display with the keyboard on the front panel of the Miniloader 2000.

Printed Circuit Board A3 (Slave Processor)

This board contains the Slave Processor. There are two Slave Processors in the Miniloader 2000. That means two printed circuit boards A3. The purpose of those boards is to monitor all the switches and sensors, to control motors and solenoids and to drive functional modules of the cycle. The Slave Processors are supervised by the Main Processor and they communicate with the Main Processor by a serial RS 232 interface.

Printed Circuit Board A4 Magazine Interface

This board acts as an interface between the Slave Processor Board A3/2 and the sensors, motors, solenoids and valves which are controlled by the Slave Processor. All the signals between the Slave Processor Board A3/2 and the peripheral devices become electrically decoupled by the Circuit Board A4. This is done by optocouplers which are using light instead of electric current for the transmission of the signal. Signals from the Slave Processor which are used to drive an output become amplified by the Circuit Board A4. The amplification of the signals for the motors is done by solid state relays. At the connection to the motors the solid state relays are connected in parallel to a voltage depending resistor (VDR). The resistance of the VDR depends on the height of the voltage at the VDR. The VDRs are used to protect the solid state relays from the inductive voltage generated by the motors and solenoids when they are switched. Two circuits to control and to drive the two stepper motors (Film Pocket and Processor Interface). The circuits consist mainly of one stepper motor controller and two driver circuits. The circuits control the current of the stepper motor and they generate the phase shift needed for the four windings of the stepper motors. With the signal at the input HALF/<MO>FULL<D> it is possible to select between half step mode and full step mode. At half step mode the step angle of the stepper motor is half the step angle of the full step mode. The signal at the CTRL (control) input is always set to a high level that means



STEPPER MOTOR CURRENT

CHOPPER SIGNAL

figure 3-12

the chopper acts always on the phase lines A, B, C and D. The chopper is needed for the limiting of the stepper motor current. The current is limited by switching off the motor each time, the current increases above a certain limit. The current remains switched off for a pulse time of the chopper signal. The chopper frequency is determined by an RC-combination. The chopping can be adjusted by R38.

Printed Circuit Board A5 Film Pocket

The circuit board A5 is located on the Magazine Film Pocket. The circuit board A5 has an internal 24 V regulator used to drive solenoids. The regulated supply voltage of 5 V is supplied by the printed circuit board A4 so there is no regulation for the 5 volts on the circuit board A5. On the circuit board there are the sensors B58/M_PU_ER, B57/M_PU_M and B56/M_PU_EF for the position detection of the magazine sucker bar. The sensor signals from the circuit board A7are fed through the circuit board A5. All the signals from the sensors are connected to operational amplifiers to compensate for electrical noise and to determine the high level for the output of the sensors for voltages above 2.5 V and the low level for voltages below 2.5 V. The magazine empty sensor can be switched on and off by this circuit board.

Printed Circuit Board A6/1-2 Magazine Sense

There are two Circuit Boards A6 in the Miniloader 2000. The purpose of the Circuit Boards A6 is to sense the sizes of the Magazines inserted into the Miniloader 2000. The output of the signals from the circuit boards A6 are all connected in parallel. Only one circuit board A6 will be active at a time. The multiplexing of the two circuit boards A6 is done by a signal at the cathodes of the sensor transmitter diodes. As long there is a high signal at the cathodes of the transmitter diodes, the receiver transistor will be switched off, no matter if the sensor is interrupted or not. By switching the voltage at the cathodes of the transmitter diodes to ground, the sensors on the selected circuit boards A6 become active.

Printed Circuit Board A7 Level Control

This board contains only the two sensors for the position detection of the Film Pocket. (Home Position, Magazine/Cassette Level B30, B32).

Printed Circuit Board A8 Cassette Interface

This board is used as an interface between the slave Processor board A3/1 and the peripheral devices like all sensors, motors and solenoids. It works similar to PCB A4.

Printed Circuit Board A9 DC Motor Driver

This board controls the two DC-motors M5 (Cassette Opening) and M2 (Cassette Input). The circuits on this board also regulates the current through the DC-motors. The motors become switched off, if the current exceeds a certain limit and the motor becomes switched on again a short time after this. This results in a chopped signal if the current reaches its maximum value. The driver circuit L6203 is identical to the stepper motor controller on the circuit board A4 where it is used to drive the Film Pocket stepper motor. The signals at pin 11 (EN = enable of the L6203) and pin 10 (SNS = output of the sensed value of motor current) are used to limit the current when the motors are switched on or if they are mechanically blocked. The additional circuits LM339 and 74LS221 are used to determine the maximum current and the off-time for the chopping during current regulation. The operational amplifier LM339 acts as a comparator to determine the maximum current. The circuit 74LS221 is used to determine the off-time during the chopping of the output of driver L6203.

Printed Circuit Boards A10/1-2 Odometer

These two boards contain the Odometers used for the detection of Cassette Length and the position of the Cassette Opener. The PCB contains a sensor and a circuit used to detect the direction of the rotation of the timing disc.

Software

To understand the structure of the software it is very helpful to know something about the basic structure of the hardware. Therefore here is a short description of the hardware:

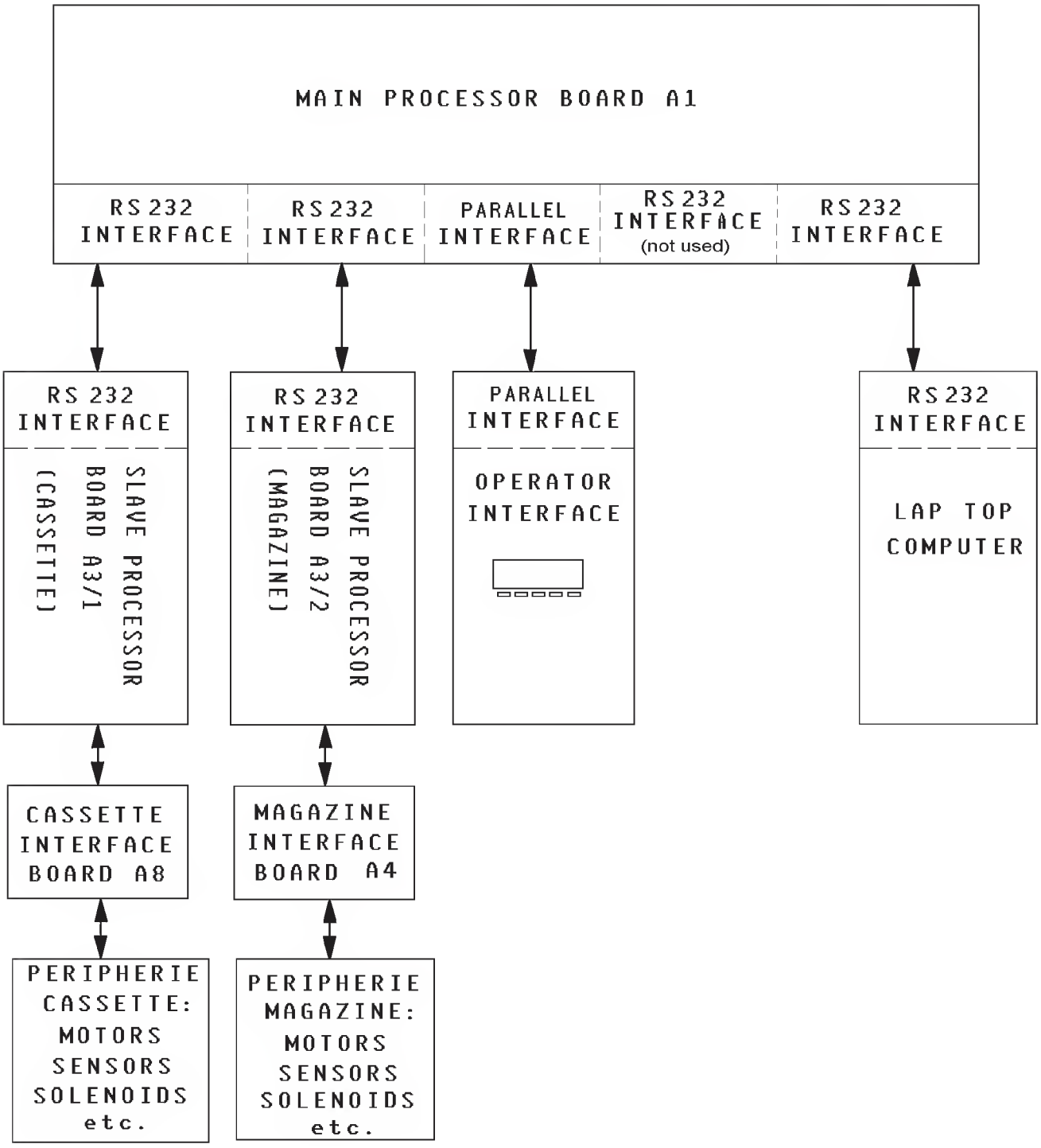


figure 4-1

The ML 2000 / ML2000 P is controlled by the Main Processor Board A1. This Board communicates with the two slave processor board A3/1 and A3/2, the Display and with the Lap Top computer. All synchronizing of the different microprocessor boards are performed by the main processor board A1.The program on the main processor board is a multi tasking program. This means that several functions can be operated in parallel. Of course these functions (they are called tasks) do not work independently, therefore the tasks interchange information which is needed for synchronization. These information exchanges are called events.

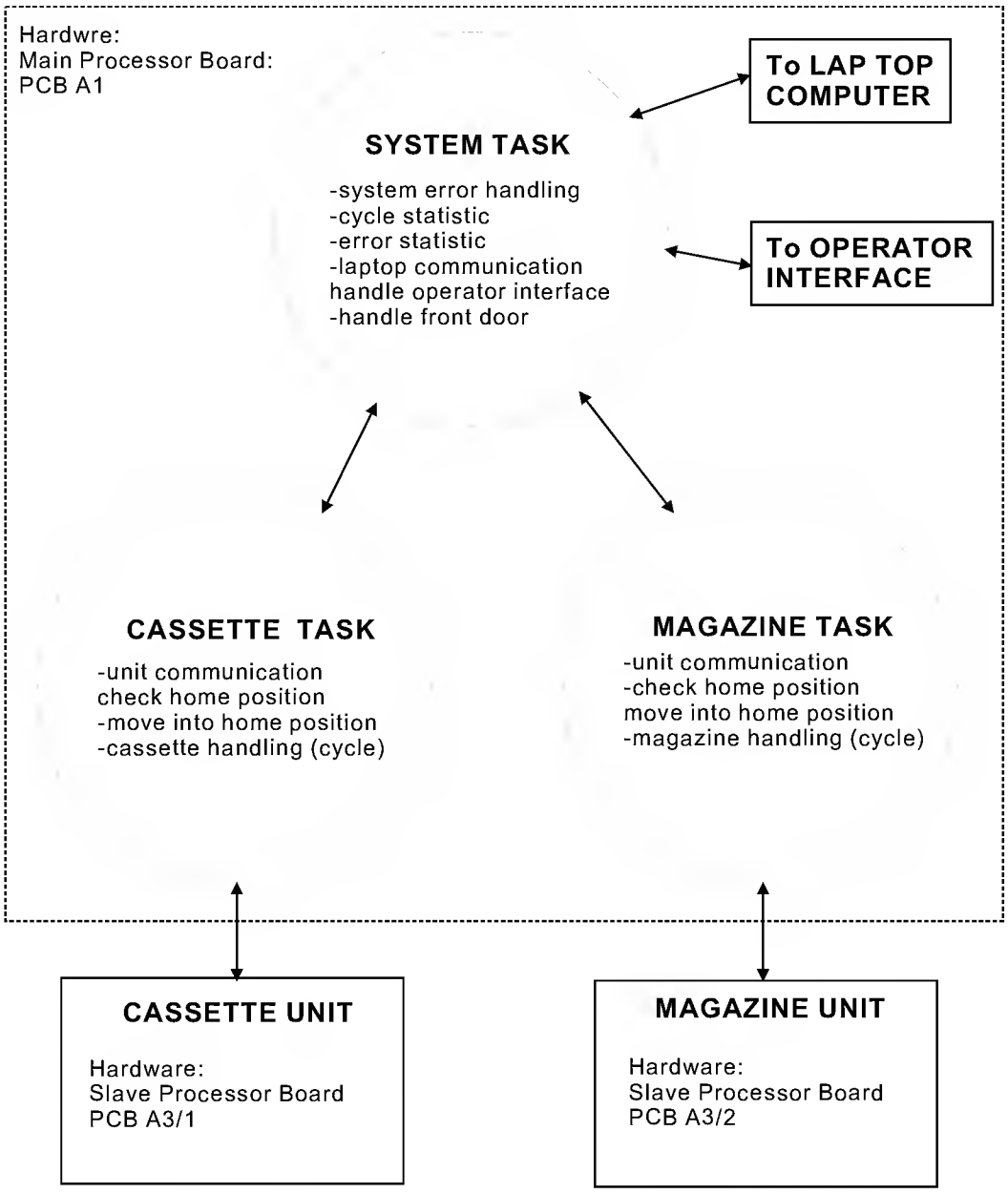


figure 4-2

1. Administrator Task

The Administrator Task takes control over the ML2000 / ML2000 P. The administrator task controls the complete ML2000 / ML2000 P in case of any error or failure of the system. The Administration Task communicates with all the other tasks and the Lap Top computer via events and mailboxes.

2. Cassette Task

This task controls the functions for the cassette (for example feed in cassette, open cassette etc.). The cassette task communicates with the administrator-, magazine-, and interface unit task via events and mailboxes. The cassette task starts an error handling in case of any error in a function of the cassette unit.

3.Magazine Task

This task controls the magazine unit (magazines, filmpocket). The magazine task communicates with the cassette task and administration task via events and mailboxes. The magazine task starts the error handling in case of any error in the magazine unit before the administration task takes control of the complete system.

Units

All the units are controlled by the tasks explained above. In the ML2000 / ML2000 P there are four units, the operator interface and the connection to the Laptop computer. The software for the four units is located on three microprocessor board. The programs for the units are split into routines which are controlled by the corresponding tasks. The routines work on the lowest level of the software. That means the details of the operation during a cycle are performed by these routines (in the following called functions). The functions switch the motors, solenoids etc. they check the sensors and they create error messages which are transmitted to the tasks for error handling. To illustrate how the software interacts, there is a simplified chart of part of a cycle shown in the figure on the next page.

Laptop Computer

The Lap Top Computer is not a part of the ML2000 / ML2000 P but it is used as a powerful diagnostic tool for trouble shooting and adjusting of the ML2000 / ML2000 P. The Lap Top Computer communicates via a RS232 interface with the ML2000. If the Lap Top Computer is connected to the ML2000 / ML2000 P it can be used to:

- Store statistics on hard disc
- Display statistics
- Monitor Sensor signals (Sensor test)
- Switch components on/off
- Check components
- Trouble shooting etc.

Sequence Of Operation (ML2000)

Note

The sequence of events differs slightly from cycle to cycle. This is due to the fact that 3 independent micro processors are working in parallel(SYSTEM UNIT, CASSETTE UNIT and MAGAZINE UNIT). The events described here are from a normal cycle without errors.

CONDITIONS:

The described cycle is a normal cycle (unload/load).
The previous FILM is already in the RECEIVING MAGAZINE.
18x24 MIN-R CASSETTE.
18x24 MAGAZINE in level 1.
RECEIVING MAGAZINE 18x24 is inserted and not full

1. The operator feeds in a CASSETTE.

2. SENSOR B2/C_IN_R CASSETTE REGISTRATION is actuated and the following actions are started:
a. The green light is switched off and the amber light is switched on.
b. The CASSETTE is transported to the CASSETTE END SWITCHE B6.
c. The CASSETTE OPENER MOTOR M5/C_OP is switched on to move the OPENER partially down.
This is done to save time. The pulses generated by the ODOMETER A10/2 determine the stop position of the CASSETTE OPENER. The counting of the pulses is started as soon as SENSOR B15/C_OP_EO CASSETTE END SWITCH OPEN is released.

NOTE

The CASSETTE OPENER MOTOR M5/C_OP is only started if the CASSETTE SUCKER BAR is in the rear position (e.g. SENSOR B18/C_PU_ER is actuated). This is a safety precaution to avoid damage of the CASSETTE SUCKER BAR.

3. The CASSETTE INPUT FLAP is closed. Motor M1/C_IF is switched on until SENSOR B4/C_IF_EC CASSETTE INPUT FLAP END SWITCH is actuated by the INPUT FLAP.

4. The SOLENOID VALVE Y11/M_PU_B MAGAZINE BLOWING is switched on. This opens the pressure line of the COMPRESSOR, because the COMPRESSOR cannot be started when there is pressure in the pressure line.

5. The COMPRESSOR M16/M_CP is turned on. The COMPRESSOR is turned on at this early time, because it takes some time to build up the pressure in the pneumatic system.

6. The SOLENOID VALVE Y11/M_PU_B MAGAZINE BLOWING is switched off.
The SOLENOID VALVE Y12/M_PU_S MAGAZINE SUCKING is switched on. This should prevent water from being sprayed onto the film.

7. The STEPPER MOTOR RECEIVING MAGAZINE M13/M_PI is switchd on.

8. CASSETTE CENTERING is started. If SENSOR B10/C_CE_EO CENTERING BARS END SWITCH OPEN is not actuated, the CASSETTE CENTERING MOTOR M4/C_CE is switched on in reverse to fully open the CENTERING BARS. This is important, because the travel of the CENTERING BARS gives the

cassette length.
a. The CASSETTE CENTERING MOTOR M4/CE is switched on in forward direction until SENSORS B11/C_CE_CL and B12/C_CE_CR are actuated by the CASSETTE. During this time the ODOMETER A10/1 generates count pulses (cassette length pulses).
b. The message " CASSETTE SUCCESSFULLY CENTRED " and the cassette length is sen1 back to the SYSTEM UNIT.
c. Y3/C_FC FILM CHUTE CYLINDER is actuated to hold the FILM CHUTE in the closed (18x24) position. If the FILM CHUTE is not in the correct position, the COMPRESSOR is switched on and the FILM CHUTE is move to the closed position. The position is checked with SENSOR B5/C_FC_C.

9. It is checked if the INPUT FLAP is closed. The message "INPUT FLAP is OK " is sent back to the SYSTEM UNIT.
It is checked if CASSETTE SIZE and RECEIVING MAGAZINE SIZE are equal. If not, the CASSETTE will be ejected.

10. The MAGAZINE COVERS are checked to see if the MAGAZINES are closed. The message with the magazine status is sent back to the SYSTEM UNIT.

11. The STEPPER MOTOR RECEIVING MAGAZINE INTERFACE M13/M_PI is switched on.

11. The FILM POCKET moves to the selected level (in this example to level 1) to pick up a fresh FILM. The message "FILMPOCKET REACHED THE SELECTED LEVEL" is sent back to the SYSTEM UNIT.

12. The CASSETTE is opened.
a. The CASSETTE OPENING MOTOR M5/C_OP was stopped in step 2 and is now switched on again. The CASSETTE OPENER moves down to its bottom position. The bottom position is determined by count pulses of the ODOMETER A10/2 (48 pulses).
b. After the bottom position is reached, the CASSETTE OPENER SOLENOID Y4/C_OP is switched on.
c. The CASSETTE OPENER MOTOR M5/C_OP is switched on in reverse direction to lift the CASSETTE LID.
d. The CASSETTE OPENER MOTOR M5/C_OP is switched on again and the OPENER moves up to the upper position (HOME POSITION). Motor M5/C_OP is switched off as soon as SENSOR B15/C_OP_EO is reached. The CASSETTE OPENER SOLENOID Y4/C_OP is switched off.
e. The message "CASSETTE IS OPEN" is sent back to the SYSTEM UNIT.
f. It is checked if the FILM CHUTE is in the correct position (SENSOR B5/C_FC_C actuated). If not, If not, the CASSETTE will be closed and ejected.

13. The ROLLER MOTOR M7/C_PU_RO in the CONVEYOR is switched on.

14. The MAGAZINE SUCKER BAR rotates into the MAGAZINE. MOTOR M15/M_PU MAGAZINE FILM PICK UP is switched on. The FILM POCKET waits in the so called PICK UP POSITION. The fresh FILM will be picked up after the exposed FILM is unloaded from the CASSETTE. The message "FILM POCKET SUCKER BAR REACHED THE PICK UP POSITION" is sent back to the SYSTEM UNIT.

15. All MAGAZINES are opened. The MAGAZINE OPENING MECHANISM MOTOR M14/M_OP is switched on, until SENSOR B36/M_OP_EO MAGAZINE OPENING END SWITCH is actuated. The message "MAGAZINE COVERS OPEN" is sent back to the SYSTEM UNIT.

16. The FILM POCKET SUCKER BAR is rotated into the PICK UP POSITION.

17. A fresh FILM is picked up from the MAGAZINE. The FILM POCKET is transported to the MOVE OUT POSITION.

a. The SOLENOID VALVE Y11/M_PU_B MAGAZINE BLOWING is energised. Air is now blown through the MAGAZINE BLOW PIPES to separate the FILMS in the MAGAZINE.
b. The SOLENOID VALVE Y12/M_PU_S MAGAZINE SUCKING is energised. This allows vacuum to built up after the MAGAZINE SUCKER BAR reached the top FILM in the MAGAZINE.
c. The SOLENOID Y14/M_PU is energised. This tilts the MAGAZINE SUCKER BAR.
d. The STEPPER MOTOR FILM POCKET M10/M_PO is started, the FILM POCKET moves down towards the FILMS.
e. The FILM POCKET SUCKER BAR reaches the top FILM and SENSOR B61/M_PU_FS FILM AT SUCKER BAR is actuated.
f. The FILM POCKET moves further down depending on the PARAMETER ADDITIONAL STEPS. This ensures that the SUCKERS are in good contact with the FILM and that the vacuum can be built up.
g. The STEPPER MOTOR FILM POCKET M10/M_PO is switched off.
h. It is checked if the MAGAZINE is NEARLY EMPTY.
i. After a pause of 100 msec the STEPPER MOTOR FILM POCKET M10/M_PO is started in upwards direction, until the TILT POSITION is reached.
j. The STEPPER MOTOR FILM POCKET M10/M_PU is switched off.
k. The SOLENOID Y14/M_PU is switched off.
l. 150 msec later the SOLENOID VALVE Y11/M_PU_B is switched off. Air is no longer blown into the MAGAZINE.
m. The STEPPER MOTOR FILM POCKET M10/M_PO is switched on again to reach the move out position.
n. The STEPPER MOTOR FILM POCKET M10/M_PO is switched off when the MOVE OUT POSITION is reached.
o. After a pause of 100 msec the DOUBLE SHEET DETECTION SOLENOID Y15/M_PU_DS is energised. The DOUBLE SHEET DETECTOR moves forward to detect if one or more FILMS are picked up.
p. 200 msec later SOLENOID Y15/M_PU_DS is switched off.
q. It is now checked if the MAGAZINE is empty.
r. The message "FILM POCKET SUCKER BAR REACHED THE MOVE OUT POSITION" is sent back to the SYSTEM UNIT.

18. The exposed FILM is picked up from the CASSETTE.
a. The SOLENOID VALVES Y5/C_PU_S and Y6/C_PU_VE are energised. This allows vacuum to built up after the CASSETTE SUCKERS reached the FILM in the CASSETTE.
b. The FILM PICK UP MOTOR M6/C_PU is switched on in forward direction. The CASSETTE SUCKER BAR CARRIAGE travels forward into the CASSETTE.
c. 300 msec after the start of MOTOR M6, the SOLENOID Y7/C_PU SUCKER BAR TILTING is energised. This tilts the CASSETTE SUCKER BAR.
d. When SENSOR B17/C_PU_EF FILM PICK UP END SWITCH FRONT is reached, the FILM PICK UP MOTOR M6/C_PU is switched off. A pause of 500 msec is started.
e. The SOLENOID Y7/C_PU is switched off. This causes the CASSETTE SUCKER BAR to tilt back to separate the FILM from the CASSETTE SCREEN.
f. The FILM PICK UP MOTOR M6/C_PU is switched on in backward direction.
g. The CASSETTE SUCKER BAR ASSEMBLY travels backwards.
h. The FILM interrupts the SENSOR B20/C_PU_VO VACUUM OFF.
i. The VACUUM OFF TIME is started.
j. At the end of the VACUUM OFF TIME the SOLENOID VALVES Y5/C_PU_S and Y6/C_PU_VE are switched off. This vents the vacuum system. The FILM is released from the CASSETTE SUCKERS and is picked up by the CONVEYOR FRONT ROLLERS and is transported to the FILM CHUTE.
k. After SENSOR B18/C_PU_ER FILM PICK UP END SWITCH REAR is actuated the FILM PICK UP MOTOR M6/C_PU is switched off.
l. After SENSOR B20/C_PU_VO VACUUM OFF saw the trailing edge of the FILM, the message FILM OUT OF THE CASSETTE is sent back to the SYSTEM UNIT.

m. From now on SENSOR B24/C_RM_E (RECEIVING MAG. EMPTY) is checked.

18. Rotate the FILM POCKET SUCKER BAR fully out of the MAGAZINE.
a. MOTOR M15/M_PU MAGAZINE FILM PICK UP is switched on in reverse direction.
b. SENSOR B58/M_PU_ER FILM PICK UP END SWITCH REAR is reached.
c. MOTOR M15/M_PU_ER is switched off.
d. The message "FILM POCKET SUCKER BAR REACHED THE REAR POSITION" is sent back to the SYSTEM UNIT.

19. The CASSETTE ROLLER MOTOR M7 is stopped 1.5 sec. after B20 detected the FILM.

20. The FILM POCKET moves to the CASSETTE LEVEL. The STEPPER MOTOR FILM POCKET M10/M_PO receives the calculated amount of pulses to move the FILM POCKET up to the CASSETTE LEVEL. SENSOR B32/M_PO_ML MAGAZINE LEVELS monitors in addition the amount of levels between the MAGAZINE LEVEL and the CASSETTE LEVEL. The STEPPER MOTOR M10 is switched off as soon as the FILM POCKET reaches the CASSETTE LEVEL. During the upward movement of the FILM POCKET, the MAGAZINES become closed. MOTOR M14/M_OP MAGAZINE OPENING is switched on. The message "FILM POCKET REACHED THE CASSETTE LEVEL" is sent back to the SYSTEM UNIT.

21. The FILM POCKET SUCKER BAR is rotated into the open CASSETTE.
a. MOTOR M15/M_PU FILM PICK PICK UP is switched on in forward direction.
b. MOTOR M15/M_PU is switched off as soon as SENSOR B56/M_PU_EF FILM PICK UP END SWITCH FRONT is reached.
c. The message "FILM POCKET SUCKER BAR REACHED THE FRONT POSITION" is sent back to the SYSTEM UNIT.

22. Depending on the amount of steps given in the PARAMETER LOWER POCKET the FILM POCKET is lowered. This prevents the fresh FILM from floating out of the CASSETTE.
a. The STEPPER MOTOR FILM POCKET M10/M_PO receives the desired amount of pulses to move the FILM POCKET down.
b. The message "FILM POCKET IS LOWERED" is sent back to the SYSTEM UNIT.

23. The FILM is blown off from the SUCKERS.
a. The SOLENOID VALVE Y10/M_PU_BS MAGAZINE BLOW SUCKER is switched on for 17 msec. This frees the FILM from the SUCKERS. The blowing may be repeated up to 10 times (17 msec blow 0.5 sec pause) if SENSOR B61/M_PU_FS FILM AT SUCKER BAR is not deactuated.
b. The message "FILM IS BLOWN OFF FROM THE FILM POCKET SUCKER BAR SUCKERS" is send back to the SYSTEM UNIT.

24. The COMPRESSOR M16/M_CP is switched off.

25. The FILM POCKET SUCKER BAR is tilt back. SOLENOID Y14/M_PU SUCKER BAR TILTING is switched off.

26. The FILM POCKET SUCKER BAR is transported to the MOVE OUT POSITION. It has to be transported up, so that it can be rotated out of the CASSETTE. MOTOR M10/M_PO STEPPER MOTOR FILM POCKET is switched on in upward direction, until the CASSETTE LEVEL BRACKET interrupts SENSOR B32/M_PO_ML MAGAZINE LEVEL. The message "FILM POCKET REACHED THE MOVE OUT POSITION" is sent back to the SYSTEM UNIT.

27. The FILM POCKET SUCKER BAR is rotated to the MIDDLE POSITION. MOTOR M15/M_PU MAGAZINE FILM PICK UP is switched on in reverse direction. The MOTOR is switched off as soon as

SENSOR B57/M_PU_M FILM PICK UP MIDDLE POSITION is no longer interrupted. The message "FILM POCKET SUCKER BAR REACHED THE MIDDLE POSITION" is sent back to the SYSTEM UNIT.

28. It is checked to see if the MAGAZINES are really closed. The message "MAGAZINE COVERS ARE CLOSED" is sent back to the SYSTEM UNIT.

29. The SOLENOID VALVE SV Y10/M_PU_BS is energised to vent the pressure system.

30. The CASSETTE OPENER MOTOR M5/C_OP is started downward to close the CASSETTE. The pulses from the ODOMETER A10/2 are counted, after SENSOR B15/C_OP_EO is deactuated, to reach the bottom position of the CASSETTE OPENER. This closes the CASSETTE. MOTOR M5/C_OP is switched off. After a pause of 100 msec MOTOR M5/C_OP is switched on in upward direction. When the CASSETTE OPENER reached the LOWER MIDDLE POSITION, the message "CASSETTE IS CLOSED" is sent back to the SYSTEM UNIT.

31. It is then checked to see if the exposed FILM is transported into the RECEIVING MAGAZINE.

32. Open the CASSETTE INPUT FLAP. Motor M1/C_IF.

33. The FILM POCKET moves to HOME POSITION.

34. SOLENOID VALVES Y10/M_PU_BS and Y11/M_PU_B are switched off. Venting off the pressure system is ended.

35. The STEPPER MOTOR RECEIVING MAGAZINE INTERFACE is switched off. (M13)

36. It is then checked to see if the MAGAZINE UNIT is in HOME POSITION. The FILM POCKET must be in HOME POSITION and the status of the following SENSORS must be:
B36/M_OP_EO..... MAGAZINE OPENING END SWITCH.....OFF
B37/M_OP_EC ..... MAGAZINE CLOSING END SWITCH.....ON
B56/M_PU_EF..... FILM PICK UP END SWITCH FRONT .....OFF
B57/M_PU_M ..... FILM PICK UP MIDDLE POSITION .....OFF
B58/M_PU_ER ..... FILM PICK UP END SWITCH REAR.....ON
The message "MAGAZINE UNIT IN HOME POSITION" is sent back to the SYSTEM UNIT.

37. The CASSETTE is fed out. The CASSETTE INPUT MOTOR M2/C_IN is switched on and the CASSETTE is transported out of the ML2000. The CASSETTE actuates SENSOR B2/C_IN_R CASSETTE REGISTRATION and MOTOR M2 is switched off.

38. When the OPERATOR takes out the CASSETTE SENSOR B2/C_IN_R CASSETTE REGISTRATION is deactuated and at the OPERATOR CONTROL PANEL, the amber light is switched off and the green light is turned on. A new cycle can be started.

39. In standby periodic checks are made to see if the CASSETTE UNIT and the MAGAZINE UNIT are in HOME POSITION.

CUSTOMER EQUIPMENT SERVICES KODAK AG STUTTGART